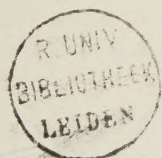


THE BRIDGING OF COLONIC DEFECTS
BY MEANS OF THE
INTERPOSITION OF SEGMENTS
OF THE SMALL INTESTINE

INAUGURAL DISSERTATION

ZUR ERLANGUNG DER DOKTORWUERDE
DER MEDIZINISCHEN FAKULTAET
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The idea of enteroplastic reestablishment of colonic continuity is not new. Nicoladoni, in 1887³² was probably the first to describe the operation in its present sense, and early reports of clinical results^{64, 65} as well as animal experimentation^{17, 18, 19, 23, 24, 25, 58, 59} indicated its feasibility. A series of subsequent reports have affirmed the value of the procedure in selected cases.

This communication will attempt to outline the principles and technic of the operation, to discuss its applicability. A report of five cases operated at the surgical clinic of the University of Basel, Switzerland* will be presented. An extensive bibliography is appended in an effort to bring some order to the widely scattered references, a condition which makes investigation difficult.

GENERAL CONSIDERATIONS:

Although Nicoladoni described two operations for reestablishing colonic continuity, only the first involves the interposition of isolated segments of the small intestine, and this operation has been the only one for which reports of clinical application have been found. Briefly, a convenient loop of ileum or jejunum is isolated with its vascularization and mesentery intact, and is anastomosed across the gap to be repaired. This is usually an ileum-loop interposed to replace the sigmoid and adjacent parts of the descending colon.

The operative technic is a straightforward application of the well-known principles of entero-anastomosis. It should be mentioned, however, that experiments on dogs^{9, 19, 20, 21, 43} have indicated that antiperistaltic interposition, as well as excessively long segments, may predispose to peptic ulcers in the transplant. It is unlikely, however, that the mesenteric relationships would allow the experienced abdominal surgeon to attempt an antiperistaltic connection. He would also avoid unnecessarily long (as well as too short) segments by following general surgical principles.

The difficulty of joining the ileal segment (it is usually an ileal segment) to the short rectal stump in the depths of the pelvis poses one of the major problems in the development of this operation. It would seem that a side-to-end or side-to-side ileorectostomy would be the preferred form of union because the large communication would eliminate the

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likelihood of stricture at this point^{14, 15, 16, 26, 29, 34, 39}. However, this may be technically difficult, particularly if the rectal stump is very short . . . or impossible, if the rectal stump is absent. The alternative procedure is one of the many variations of end-to-end anastomosis, intromission, invagination, or pull-through at the rectal sphincter^{2, 4, 10, 11, 14, 15, 16, 17, 30, 37, 40, 44, 50, 60, 61, 62, 63}. All these methods have been used with success, but are sometimes complicated by the development of stenosis at the ileo-rectal junction^{1, 15, 30, 37, 40, 50}. Careful post-operative dilatation can reduce this complication^{4, 15, 30}, and it should be done routinely, beginning on the seventh or eighth post-operative day¹⁵.

The frequency of post-operative abscesses and fistulas is high; many of the cases reported in detail mention one or the other^{11, 15, 33, 34, 35, 50, 61}. However, Gohrbrandt's statement (quoted by Morl) to the effect that the inevitability of fecal fistulas compels the establishment of colostomies and condemns the operation to certain failure³⁰ is definitely unjustified pessimism and factually false. Because there is nothing in this operation that makes such complications inevitable, it can be hoped that scrupulous technic and care in posing the indications for its application might reduce their severity.

In the early years of the history of this operation considerable interest was shown in the question of the adaptation of transplanted small-intestine to its new role as a colonic substitute. There are reports of animal experiments concerning possible anatomic modifications of the mucosa and musculature^{19, 23, 24, 25, 66}. There is some evidence that dilatation with hypertrophy of the musculature does occur frequently, although changes in the mucosa are not constant^{8, 19, 25, 26}.

For the present-day surgeon, however, two facts are of primary importance:

1. The operation has been performed with success and the transplanted segment — with or without some degree of modification of its structure — almost always permits a functionally satisfactory result, in the absence of complications^{1, 2, 7, 8, 10, 11, 12, 15, 17, 27, 28, 29, 30, 33, 34, 37, 39, 40, 41, 42, 44, 46, 47, 49, 50, 51, 53, 55, 61, 63, 67}.
2. No clinically important absorption of toxic fecal constituents occurs in the ileal transplant. A complete explanation of this clinically repeatedly demonstrated fact is not yet possible. Contributing factors may be rapid passage of intestinal contents through the interposed segment^{31, 44, 54} and a certain adaptation of the mucosa to its new function (v.s.). This rapid passage without retention may be a desirable aspect of the otherwise annoying post-operative diarrhea^{8, 15, 17, 28, 29, 31, 44, 59} which probably has much in common with the diarrhea following colectomy.

Although over fifty cases are mentioned in the literature, details are not available for many of them. No doubt numerous unsuccessful attempts, and some successful ones, have not found their way into available publications. Therefore, a conclusive statement concerning mortality and results can not be made at this time, although it would seem that post-operative prognosis depends upon the usual considerations for major abdominal surgery. Long-range results have included a series of unqualified successes, and this amply demonstrated possibility certainly justifies the use of this operation in selected cases.

"Satisfactory" to "completely normal" function has been achieved: (our own cases not included)

1— 5 years in 10 cases^{11, 15, 27, 39, 55, 62, 67}

6—10 years in 3 cases^{15, 35}

11 years in 1 case¹⁵

12 years in 1 case⁶³

13 years in 2 cases^{15, 49}

20 years in 1 case⁸

In twenty-one other cases satisfactory (or better) results were reported, but the patients were followed for less than one year, or the length of time of the observation was not included in the report. Failures are so incompletely reported, and are so little characteristic of this particular operation, that no attempt will be made to evaluate them^{1, 2, 3, 4, 6, 7, 10, 15, 17, 29, 30, 31, 33, 34, 40, 50, 53, 60, 61}.

Information concerning the disorder leading to operation is available for most of the cases reported:

	Cases
Carcinoma ^{2, 4, 8, 11, 15, 36, 38, 44, 46, 53, 55, 62, 65, 67}	25
Non-specific inflammatory conditions (diverticulitis, diverticulitis tumor, perisigmoiditis) ^{1, 4, 15, 27, 33, 35}	6
Trauma (perforation of the uterus, blunt trauma to the abdomen) ^{15, 36, 50, 53, 63}	5
Gangrene (Volvulus, arterial obstruction, etc.) ^{10, 29}	2
Ulcerative colitis ^{6, 15, 31}	3
Endometriosis ⁴⁰	1
"benign stricture" ^{1, 4, 53}	1
Adhesions following gynecological operation ³⁴	1
Gastro-colic fistula necessitating resection ¹⁵	1
Polyposis ⁶	1
Post-dysenteric atrophy of the colon ⁴²	1
Tuberculosis (uncertain) ⁶¹	1

REPORT OF OUR CASES

CASE S., E.—FEMALE, BORN 1914

The present complaint began in 1952, two years after Brucellosis with systematic complications, when the patient had a two month episode of ulcerative colitis with septic fever. Thereafter stools were liquid and she was incontinent.

The following year a barium enema showed a reduced haustral relief in the transverse colon. A transversostomy was performed and resulted in a distinct improvement of her general condition.

We first saw the patient in April of 1954 and, on the basis of radiological studies showing a normal mucosa proximal to the colostomy, suggested the re-establishment of intestinal continuity.

The operation was performed on April 27, 1954. From a point a hands-breadth distal to the colostomy and extending to the promontorium the left colon was dissected out and removed. A twenty centimeter segment of ileum, about fifteen centimeters above the ileocecal valve, was isolated with its mesentery intact. Its proximal end was anastomosed to the transverse colon. From a second incision in the midline dorsal to the anus the remaining rectal stump was excised, without injury to the anal sphincter. The lower end of the ileal segment was pulled through the anal sphincter and sewn to the anal mucosa in such a way that about seven centimeters extended beyond the anus.

The immediate post-operative period was untroubled and a barium enema after three weeks showed no evidence of stenosis or insufficiency of the anastomosis. The moderate post-operative diarrhea was well tolerated. Four weeks after the operation an abscess dorsal to the anus appeared and was drained. The original transversostomy was eliminated by means of excision and end-to-end anastomosis in the fourth post-operative week. Six weeks after the ileo-colo-rectoplasty the seven centimeters of ileum still protruding from the anus were removed electrosurgically and about one week later the patient was discharged in satisfactory condition.

Several days after discharge a fistula developed in the sacral region. This was accompanied by diarrhea. Chemotherapy succeeded in lessening the drainage through the fistula, and opium reduced the diarrhea. However, in the subsequent months the diarrhea increased to such a point that about fifteen kilograms of weight were lost and the patient pleaded for a restoration of her colostomy. Radiological studies four months after the intestinal transplant was created showed an image suggestive of colitis in the proximal part of the interposed ileal segment.

The patient refused all surgery except the reestablishment of a colostomy, which was done, after which we closed the distal colonic segment. At the time of discharge, the only complaint was a small fistula remaining in the sacral region; her general condition was much improved and the colostomy functioned well.

CASE J., D.—MALE, BORN 1898

The patient had been under treatment for ulcerative colitis since 1939. In 1948 intestinal obstruction necessitated colostomy (transverse colon) followed by successive operations to free adhesions, to close and intestinal perforation,

to correct a cicatricial hernia, and to drain an abscess in the abdominal wall. In 1951 a surgical correction of the colostomy as well as an abdominal revision with repair of a cicatricial hernia were performed.

In July 1951, twelve years after the onset of the ulcerative colitis and three years after the establishment of a colostomy, intestinal continuity was re-established by means of an ileo-colo-anoplasty with left hemicolectomy. An anal fistula and insufficiency of the abdominal scar delayed closure of the preexisting colostomy until the following year. In 1953 an abscess in the gluteal region required incision.

Complete continence was never achieved after closure of the artificial anus. Nevertheless, the patient was able to reduce bowel movements to three or four a day by means of tincture of opium.

The patient first came to us in 1955 complaining of intolerable diarrhea of several months duration. The skin of the anal region was extensively macerated and showed areas of papillomatous proliferation. The patient was losing weight. A barium enema showed evidence of inflammation in the proximal part of the ileal transplant, and an image interpreted as probably being an old, covered perforation leading from the interposed segment.

The operation was performed in October 1955 and an eighteen centimeter long section of colon and the adjacent proximal part of the ileal transplant were removed. Grossly, the piece was typical for ulcerative colitis. Numerous adhesions were divided. A side-to-side colo-ileostomy reestablished continuity.

Microscopic examination confirmed the diagnosis of severe ulcerative inflammation of the proximal part of the transplant with pronounced stenosis of the anastomosis.

The post-operative period was marred by hemorrhage from the drains and the rectum during the first two days. Seven weeks later an anal fistula was excised, and healed satisfactorily by second intention.

After a brief period of continence, which was at its best five months after the operation, chronic diarrhea set in and, together with the development of a perianal fistula, caused us to abandon the attempt to avoid an artificial anus. In June 1956 an axial ileostomy was created. The following month a total colectomy (ileum distal to the ileostomy, colon, transplant, and rectum) was performed. It was the seventeenth abdominal intervention performed upon this patient.

CASE Y., N.—MALE, BORN 1924

In 1953, following an acute febrile period, the patient was examined for the cause of abdominal pain with rectal and urinary tenesmus. A sigmoido-vesical fistula was discovered.

On October 23, 1953 an artificial anus was established in the transverse colon because of stricture of the sigmoid.

A laparotomy performed on March 15, 1954 confirmed the existence of a tumor in the region of the sigmoid. The mass was the size of a small infant's head. Because of the known pulmonary tuberculosis of this patient, the tumor was suspected to be a specific lesion. The poor general condition of the patient did not permit removal of the tumor, although the fistula between the sigmoid and the bladder was excised.

Cystoscopic examination showed that the fistula remained closed after the operation. However, another fistula, leading from the sigmoid to the exterior along one of the drains placed at operation, developed during the post-operative period. The inflammatory mass around the sigmoid decreased in size for a while after the operation, but later became as large as it was before.

The patient came to us for the first time about a year later. Some pus, but no intestinal contents, was being eliminated from the fistula. We were of the opinion that the tumor was most likely a so-called "diverticulitis tumor", rather than a tuberculosis lesion. We operated with the intention to define the exact nature of the mass and, if possible, to remove it.

The operation, under general anesthesia, was performed on March 28, 1955. From a transrectal incision extending to a point above the umbilicus, examination of the abdominal cavity showed no adhesions or increased fluid. A hard, sharply defined tumor about the size of a fist was found in the proximal sigmoid region. The mass was adherent to the lateral abdominal wall, but not to the small intestine. It was possible to free the tumor-carrying sigmoid from its attachments, which required the excision of the fistula tract. The tumorous portion and about five centimeters of colon on either side were resected.

In order to bridge the gap left after the removal of the sigmoid, a fifteen centimeter long segment of conveniently located ileum was isolated upon its mesentery. The pedicled segment thus isolated for use as a transplant was swung into position, and by means of a side-to-side anastomoses, spanned without tension between the distal descending colon and the proximal part of the rectum. Ileal continuity was established by means of the usual type of side-to-side anastomosis.

The operative specimen was examined by the pathologist, who confirmed the diagnosis of diverticulitis tumor.

Post-operative progress was quite satisfactory. A hemorrhagic incident on the seventeenth post-operative day, from a point between the colostomy and the anus, was easily brought under control by conservative measures. An abscess, confined to the abdominal wall, developed in the tract of one of the drains.

A barium enema, ten weeks after the operation, showed ideal relationships in the transplant.

The colostomy established the previous year was excised in the tenth post-operative week, and the ends of the colon were united end-to-end. The post-operative period followed a troublefree course.

The patient was discharged on June 1, 1955 with normal intestinal function. Slight drainage from the abscess in the abdominal wall was present.

We saw this patient again later in 1955 and he remained on our service until January 1956 in order to undergo thoracic surgery. During this period we had ample opportunity to observe the completely satisfactory results of the ileal transplant.

CASE M, G.—FEMALE, BORN 1901

Until March 1946 the patient had no disorder related to the complaint leading to her eventual operation. We saw the patient at this time, and together with the gynecological staff decided that diverticulitis with perforation was probably the cause of the sub-acute abdominal symptoms for which she had been hospitalized for five days.

A laparotomy was performed and an artificial anus was established in the transverse colon. Drains were placed in the peri-sigmoidal region which had the aspect of a diverticulitis tumor with purulent peritonitis. Remains of a barium enema undertaken before the operation were found in the abdominal cavity.

At the time of operation the patient was in decidedly poor general condition, and had severe bronchitis as well as a basal broncho-pneumonia. We were not too hopeful about the prognosis.

The post-operative course was long and difficult. The diffuse peritonitis was complicated by the development of an abscess, requiring incision and drainage, in the pouch of Douglas. Thoracentesis was done for a pleural effusion. The patient's condition improved slowly and permitted a second operation ten weeks after the establishment of the colostomy.

The abdomen was opened by a long incision along the lateral margin of the left rectus abdominis muscle. Large patches of yellow-brown discolorations indicated the extent of the peritoneal involvement, and some loops of the small intestine were united by fresh fibrous adhesions. The sigmoid was thickened and hardened to the touch and contained palpable diverticula.

The descending colon from the left colonic flexure to the lower part of the sigmoid was excised, and the stumps closed.

Approximation of the colonic stumps was impossible because the transverse colon was fixed to the abdominal wall by the colostomy. Therefore, a conveniently located loop of small intestine, about 40-50 cm. long, was divided out and the resulting four ends were closed. The continuity of the small intestine was recreated by means of an anti-peristaltic anastomosis.

A side-to-side anastomosis was made between the oral end of the isolated segment and the transverse colon as well as at the aboral end between the segment and the stump of the sigmoid. In order to accomplish this without tension on the only slightly incised mesentery, the actual point of anastomosis was about ten centimeters from the ends of the segment, and blind pouches therefore depassed the actual communication between the lumina. A Penrose drain was placed and the abdomen was closed.

The pathologist confirmed the diagnosis of diverticulitis tumor.

The post-operative period was free of complications and the patient recovered rapidly. The old colostomy functioned well.

Two weeks after the operation a barium enema encountered no resistance at either of the anastomoses.

In the fourth post-operative week the colostomy was closed.

The patient was in excellent condition at the time of her discharge three weeks after closure of the colostomy. The tendency to diarrhea was decreasing. The only difficulty in the post-operative course was the occurrence of cramps until a small abscess in the incision emptied itself spontaneously.

CASE V.,A.—MALE, BORN 1886

The patient came to us for treatment of a recto-urethral fistula consecutive to an incomplete perineal prostatectomy performed one and a half years previously. A sigmoidostomy had been established at that time in order to deviate the fecal column proximal to the fistula. The sigmoidostomy functioned well and the general condition of the patient was good.

On December 15, 1954 we excised the fistula, reached at a depth of about seven centimeters through a perineal incision. The establishment of an artificial septum (levator ani m. and pelvic connective tissue) between the rectum and the urethra as well as the presence of a catheter in the urethra did not prevent a recurrence of the fistula ten days after the operation.

Therefore, two weeks after the first operation we performed a paramedian laparotomy and an attempt was made to lower the sigmoid and pull it through the rectum. This was not possible because of the sigmoidostomy. To bridge the gap, an ileal segment was isolated; its mesentery cut back from the ends as far as possible without compromising the vascular supply; and the aboral end was drawn through the rectum until about four centimeters protruded from the anus. The oral end of the segment was united side-by-side with the lower end of the sigmoid (which had been cut back about ten centimeters). Thereby about fifteen centimeters of ileum came to lie in the peritoneal cavity. The intestinal continuity was reestablished by uniting the interrupted ileum end-to-side with the cecum.

The patient was then turned and the ileum protruding through the anus was sewn to the skin at the muco-cutaneous junction, after circular excision of the adjacent mucosa.

Post-operative progress was satisfactory. The sigmoidostomy functioned well, and there was no sign of a reappearance of the fistula. A barium enema showed a patent, but narrow, lumen in the transplant.

One month after the operation the sigmoidostomy was closed and the adjacent lumens united side-to-side. However, a fecal fistula developed here five days later. There were clinical signs of a sub-ileus, and three weeks after closure of the colostomy a barium enema showed a stenosis at the level of the former colostomy, as well as dilatation of the proximal colon.

Eleven weeks after the establishment of the ileal transplant, the patient was discharged. He was incontinent (due to absence of the ampullar-sphincteral reflex), had a prolaps of about three centimeters of rectal mucosa, and had moderate abdominal cramps. The fecal fistula had closed spontaneously.

The patient was readmitted two months later for correction of the prolaps. Eighteen days afterwards, he was discharged with one remaining complaint — incontinence, which was barely influenced by conservative means.

Five months after his last discharge, the situation demanded reconsidering the reestablishment of a colostomy. In addition to complete incontinence, a pararectal fistula had developed. Dilatation of the stenosis palpable three centimeters above the anus did not improve the situation. A barium enema demonstrated this stenosis, as well as one probably at the level of the ileo-rectal junction.

On November 29, 1955, eleven months after the creation of the ileal transplant, the abdomen was opened again. There was a stenosis at the ileo-rectal junction necessitating a sigmoidostomy. The other anastomoses were in order.

Three weeks later the patient was discharged with a well functioning colostomy. A slight secretion persisted from the para-rectal fistula.

DISCUSSION OF OUR CASES

These five cases present some interesting aspects of the attempt to bridge colonic defects by means of transplants.

In the case of S., E., which must be regarded as incomplete due to the refusal of the patient to continue attempts at surgical correction, no technical difficulties were encountered. The apparent failure of the operation seems to be due to the etiology of the original disorder—ulcerative colitis. Just why the operation caused a reappearance of the inflammation after apparent quiescence, and why the inflammation involved the transplant, remains as problematical as the very nature of the disease.

J., D., whose disorder was also ulcerative colitis, enjoyed apparent, if partial, success for almost four years. In this case also, defeat took the form of a reappearance of severe ulcerative inflammation in the proximal part of the transplant.

In the case of Y., N., operated because of stricture and fistula due to a diverticulitis tumor, there is a basic difference in the post-operative success. This patient has already achieved a restoration of intestinal function, continence, and freedom from complications never reached in the preceding two cases. The result is so satisfactory that despite the short time elapsed (one year) since the operation, one is tempted to speak of a complete cure.

The fourth case, M., G., is doing well one week after closure of the colostomy, and one month after the plastic restoration of continuity in the same session as the extirpation of a diverticulitis tumor. It is too early to evaluate the results in this case, although the early course justifies an optimistic outlook.

The last case, V., A., (recto-urethral fistula) differed from the two cases of diverticulitis tumor mostly in that it was not a success. Would early dilatation have prevented the stenosis? There is reason to believe it would have.

But more puzzling was the total incontinence, probably due to a failure of the ampullar-sphincteral reflex. No other mention of this complication was found in the literature. The most likely explanation is that the rigidity of the rectal wall due to scarring and stenosis prevented the stimulation of the mural stretch-receptors. Why the stools, which were liquid when passed through the incontinent anus, became formed when passed through the sigmoidostomy remained unexplained.

Does ulcerative colitis preclude success in attempts to bridge gaps left after resection of affected portions? Unfortunately, only three cases of colonic restoration after ulcerative colitis were found in the literature.

The case described by *Denk*⁶ is actually a by-pass of the entire colon by means of a perianal ileostomy and is not really comparable to our cases. *Most*³¹ reports a case in which post-operative diarrhea was a prominent feature, although a long-term observation is lacking. *Finsterer's* case¹⁵ died from infection two weeks after the operation.

No conclusions can be drawn from such meagre evidence, although it would seem that caution should be used in posing the indication for the operation when colitis figures in the etiology. There is no evidence concerning the possibility of diminishing the risk of recurrence by means of extensive proximal resection. These reflections are in keeping with the present point-of-view that in ulcerative colitis the colon and the rectum should be resected⁵.

SUMMARY

Five cases of repair of colonic defects by means of segments of the small intestine have been presented, along with a discussion of the general features of this operation.

The first operation, following ulcerative colitis, was an almost immediately apparent failure due to reappearance of an ulcerative inflammatory process in the region of the proximal anastomosis of the transplant. A colostomy was reestablished.

The second case, also following quiescence of ulcerative colitis, enjoyed partial success, complicated by diarrhea, for almost four years. The appearance of an ulcerative inflammatory process in the proximal part of the transplant necessitated excision of the affected part and later, ileostomy followed by total colectomy.

The third case seems to be a complete success, with restoration of normal intestinal function. The lesion necessitating sigmoidectomy was a "diverticulitis tumor".

The fourth case, also operated on for "diverticulitis tumor", shows promise of being a success. However, it is still too early to evaluate the results.

The fifth case, operated to correct a recto-urethral fistula, resulted in severe stenosis and total incontinence requiring the creation of a sigmoidostomy.

There was no operative mortality.

Although experience with this procedure is still too limited to permit definitive evaluation, caution is suggested in the use of this operation following ulcerative colitis.

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